

737

The Cleavage of the Egg of *Lepidosiren paradoxa*.

By

Agnes E. Miller, M.A.,

Department of Zoology, University of Glasgow.

With 12 Text-figures.

THE process of cleavage in *Lepidosiren* was first described by Professor Graham Kerr in his paper on the development of the external features of this animal in the 'Philosophical Transactions of the Royal Society', B, vol. excii, 1900. Since the date of Professor Kerr's expedition additional material has become available from which it has been possible to make up a more completely graduated series of segmentation stages. The following paper deals with this material and may be regarded as supplementing Professor Kerr's paper. In referring to the various stages I use the same numbers as Professor Kerr used in the paper already mentioned and also in his 'Normentafel'.¹

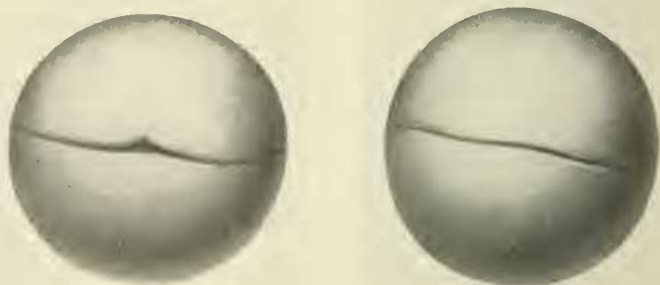
Stages 2-3.—Professor Kerr's earliest cleavage stage (2) showed the first meridional furrow bisecting the finer-grained apical cap but not extending beyond its margin; while in the second stage figured by him (3) the first meridional furrow had spread down to the equator of the egg, while the second meridional furrow at right angles to the first extended to just beyond the margin of the apical cap.

Amongst the new material is an egg (Text-fig. 1) in which the first meridional furrow has extended right to the abapical

¹ Keibel's 'Normentafeln zur Entwicklungsgeschichte der Wirbeltiere', Zehntes Heft, 1909.

pole while the second furrow has not yet made its appearance. Another egg shows the first meridional furrow extending nearly to the abapical pole and a very faint second furrow

TEXT-FIG. 1.



a. View of apical hemisphere. *b.* View of the abapical hemisphere.

TEXT-FIG. 2.



Apical hemisphere.

intersecting it and extending as far as the margin of the apical cap. A third egg (Text-fig. 2) is somewhat peculiar, inasmuch as the first meridional furrow shows a break in continuity in the region of the apical pole.

Three other eggs of the same stage of development agree in the main with those already described, except that the

first furrow is not strictly meridional but is displaced outwards some little distance from the abapical pole.

On the whole the evidence of the seven eggs obtained of this stage goes to indicate that the normal procedure of the egg of *Lepidosiren* is that the first meridional furrow is completed before the second furrow at right angles to it begins to make its appearance.

Stages 3-4.—Five eggs belong to the commencement of this period during which the egg is normally sub-divided by the completion of the first and second meridional furrows into four

TEXT-FIG. 3.



a. Apical view.



b. Abapical view.

approximately equal parts, and the third set of furrows—vertical—make their appearance. In two eggs out of the five the first and second meridional furrows are alone present and perfectly normal. Two other eggs exhibited a feature mentioned in an earlier stage, the continuity of the furrows being very faintly marked and in some places quite obliterated. In one of the two eggs one of the furrows in the region of the apical pole shows quite faintly marked: in the other egg (Text-fig. 3) in which neither the first nor the second furrows had quite reached the abapical pole, the continuity of the first meridional furrow is broken at one side and again at the abapical pole.

The last specimen of this particular stage shows the tendency

before mentioned of displacement outwards of the meridional furrow from the abapical pole.

Towards the end of this period the greater rapidity of the segmentation at the apical pole becomes more marked, and the four vertical furrows make their appearance.

Four eggs at about stage 4 were available and two showed similar development, two of the new furrows showing the normal 'vertical' position and maintaining a vertical course, while the other two furrows, instead of being vertical, have their point of origin displaced towards the apical pole so that

TEXT-FIG. 4.



Apical view.

they have become meridional, bisecting two of the quadrants. The study of sections show that all the eight nuclei are in the metaphase stage of mitosis; therefore, up at least to this stage, mitosis is synchronous throughout the egg. This paper is not intended to deal with nuclear phenomena, but it will be of interest to show an accurate drawing (Text-fig. 5) of a nucleus from the segmenting egg of *Lepidosiren* as illustrating the extraordinarily favourable nature of these nuclei for cytological investigation.

In the egg shown in Text-fig. 6 the two meridional furrows are complete. On one side of the egg (that shown in the upper half of Text-fig. 6) two vertical furrows are present, exactly in line with one another so that they have the appearance of

one continuous furrow cutting across the meridional furrow; while on the other half of the egg (Text-fig. 6, lower half) two small furrows, likewise vertical, are just beginning to develop.

TEXT-FIG. 5.



Nucleus of segmenting egg of *Lepidosiren* in early stage of mitosis. The nucleus was traced in outline under a Zeiss $\frac{1}{4}$ " homogeneous immersion objective with ocular 18, and then worked up in detail under 3 mm. apochromatic homogeneous-immersion objective with Bitumi binocular eye-piece. An attempt has been made to bring out the stereoscopic relief of the original by shading the nucleus as if it were isolated.

The divisions of the scale represent hundredths of a millimetre.

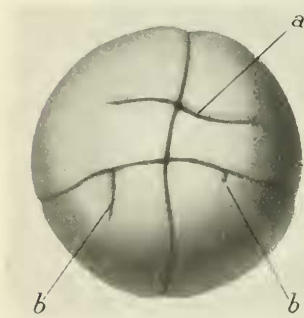
taking their origin however from the other meridional furrow than that from which the first two started.

In the fourth egg at this stage the segmentation furrows at

the apical pole are for the most part obliterated, although the fact that down at the abapical pole the two meridional furrows quite visibly intersect indicates that the egg belongs to this stage.

Stages 4-5.—Altogether six eggs were found to be approximately at this stage, and five gave evidence of further irregularities in development. One which belongs to the beginning of this period (Text-fig. 7) showed, again, lack of continuity of one of the primary meridional furrows in the region of the apical pole. Two secondary furrows arising

TEXT-FIG. 6.



Apical view.

TEXT-FIG. 7.



Apical view.

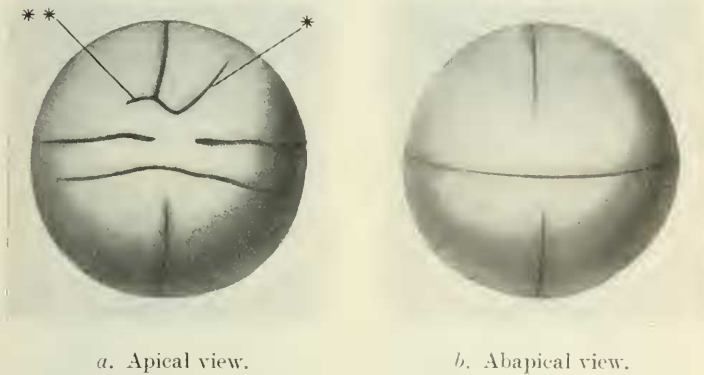
from the same meridional furrow (see upper half of Text-fig. 7) proceed in a latitudinal direction and reach the other meridional furrow, while of the corresponding furrows of the opposite side one is actually vertical in direction (see left-hand furrow in lower half of Text-fig. 7), and the other, assuming a rather latitudinal direction, runs into the meridional furrow of that side.

A second egg similar to the one already described showed again the discontinuity of the meridional furrows; neither at the apical nor the abapical poles is there any sign of intersection. Vertical furrows appear in one-half of the egg (lower half of Text-fig. 8, *a*), and in the other (upper half in Text-fig. 8, *a*) a short latitudinal groove grows out from the meri-

dional furrow as seen on the right side of the figure. Before this furrow has progressed very far another furrow * (Text-fig. 8, *a*)¹ grows down from it towards the abapical pole bisecting the quadrant; on the other side of that same meridional furrow there is an indication of a similar latitudinal furrow (**).

The third specimen showed practically the same arrangement and development of furrows as the egg shown in fig. 5 of Professor Kerr's 'Philosophical Transactions' paper. One

TEXT-FIG. 8.

*a.* Apical view.*b.* Abapical view.

meridional furrow is rather displaced, and one of the furrows of the third set growing from it is definitely latitudinal (Text-fig. 9, right lower quadrant).

To quote one more example illustrative of irregularity of segmentation: in the egg represented in Text-fig. 10 one of the two primary meridional furrows (the one which is horizontal in the figure) is perfectly normal but the other shows a distinct break at the apical pole, the portion next the apical pole in one hemisphere (that which is above in Text-fig. 10) having undergone a distinct displacement. As seen in the figure the amount of this displacement increases as the apical pole is approached.

¹ Which is however in this case uncomplicated by any branching or distortion.

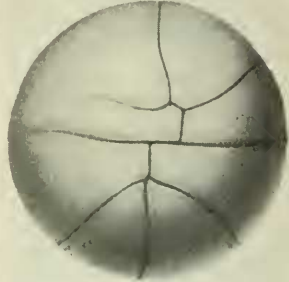
The fifth specimen, illustrated by Text-fig. 11, is interesting mainly from the fact, not shown in the drawing, that one of the meridional furrows is markedly displaced outwards from the region of the abapical pole.

TEXT-FIG. 9.



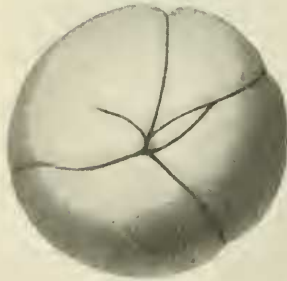
Apical view.

TEXT-FIG. 10.



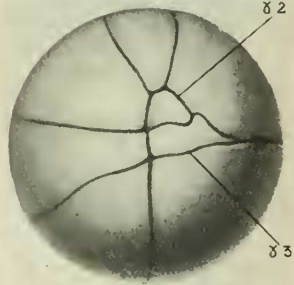
Apical view.

TEXT-FIG. 11.



Apical view.

TEXT-FIG. 12.



Apical view.

The last egg belonging to this period of development (Text-fig. 12) illustrates very clearly the kind of irregularities in the position of the furrows which do so much to obscure the process of segmentation from now on. In the right half of the figure the two furrows which would normally be vertical

(γ 2 and γ 3) are seen to be displaced in each case so that their outer ends reach one of the meridional furrows, and in the case of one of them the furrow has become practically latitudinal. Owing to the increasing frequency of such displacements combined with increasing 'loss of step' of the various blastomeres in their successive fissions, the regularity of the segmenting process becomes from now onwards completely obscured.

In conclusion I desire to thank Professor Graham Kerr both for providing me with the material on which these notes are based, and also for his kind supervision during the course of the work. I should like further to thank the Carnegie Trust for providing the illustrations to this paper, and Mr. A. Kirkpatrick Maxwell for the care and skill with which he has carried them out.